Robert A Heinlein

# Blowups Happen

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"PUT down that wrench!"

The man addressed turned slowly around and faced the speaker. His expression was hidden by a grotesque helmet, part of a heavy, lead-and-cadmium armor which shielded his entire body, but the tone of voice in which he answered showed nervous exasperation.

"What the hell's eating on you, doc?" He made no move to replace the tool in question.

They faced each other like two helmeted, arrayed fencers, watching for an opening. The first speaker's voice came from behind his mask a shade higher in key and more peremptory in tone. "You heard me, Harper. Put down that wrench at once, and come away from that 'trigger'. Erickson!"

A third armored figure came from the far end of the control room. "What 'cha want, doe?"

"Harper is relieved from watch. You take over as engineer-of-the-watch. Send for the standby engineer."

"Very well."His voice and manner were phlegmatic, as he accepted the situation without comment. The atomic engineer whom he had just relieved glanced from one to the other,then carefully replaced the wrench in its rack.

"Just as you say, DoctorSilard , but send for your relief, too. I shall demand an immediate hearing!" Harper swept indignantly out, his lead-sheathed boots clumping on thefloorplates .

DoctorSilard waited unhappily for the ensuing twenty minutes until his own relief arrived. Perhaps he had been hasty. Maybe he was wrong in thinking that Harper had at last broken under the strain of tending the most dangerous machine in the world-the atomic breeder plant. But if he had made a mistake, it had to be on the safe side-slips must not happen in this business; not when a slip might result in atomic detonation of nearly ten tons of uranium-238, U-235, and plutonium.

He tried to visualize what that would mean, and failed. He had 'been told that uranium was potentially twenty million times as explosive as T.N.T. The figure was meaningless that way. He thought of the pile instead as a hundred million tons of high explosive, or as a thousandHiroshimas . It still did not mean anything. He had once seen an A-bomb dropped, when he had been serving as a temperament analyst for the Air Forces. He could not imagine the explosion of a thousand such bombs; his.brain balked. Perhaps these atomic engineers could. Perhaps, with their greater mathematical ability and closer comprehension of what actually went on inside the nuclear fission chamber, they had some vivid glimpse of the mind-shattering horror locked up beyond that shield. If so, no wonder they tended to blow up- He

sighed. Erickson looked away from the controls of the linear resonant accelerator on which he had been making some adjustment.

"What's the trouble, doc?"

"Nothing.I'm sorry I had to relieve Harper."

Silardcould feel the shrewd glance of the big Scandinavian. "Not gettingthe jitters yourself, are you, doc? Sometimes you squirrel-sleuths blow up, too-"

"Me? I don't think so. I'm scared of that thing in there-I'd be crazy if I weren't."

"So am I," Erickson told him soberly, and went back to his work at the controls of the accelerator. The accelerator proper lay beyond another shielding barrier; its snout disappeared in the final shield between it and the pile and fed a steady stream of terrifically speeded up sub-atomic bullets to the beryllium target located within the pile itself. The tortured beryllium yielded up neutrons, which shot out in all directions through the uranium mass. Some of these neutrons struck uranium atoms squarely on their nuclei and split them in two. The fragments were new elements, barium, xenon, rubidium-depending on the portions in which each atom split. The new elements were usually unstable isotopes and broke down into a, dozen more elements by radioactive disintegration in a progressive reaction.

But these second transmutations were comparatively safe; it was the original splitting of the uranium nucleus, with the release of the awe-inspiring energy that bound it together-an incredible two hundred million electron volts-that was important-and perilous.

For, while uranium was used to breed other fuels by bombarding it with neutrons, the splitting itself gives up more neutrons which in turn may land in other uranium nuclei and split them. If conditions are favorable to a progressively increasing reaction of this sort, it may get out of hand, build up in an unmeasurable fraction of a micro-second into a complete atomic explosion-an explosion which would dwarf an atom bomb to pop-gun size; an explosion so far beyond all human experience as to be as completely incomprehensible as the idea of personal death. It could be feared, but not understood.

But a self-perpetuating sequence of nuclear splitting, just wider the level of complete explosion, was necessary to the operation of the breeder plant. To split the first uranium nucleus by bombarding it with neutrons from the beryllium target took more power than the death of the atom gave up. In order that the breeder pile continue to operate it was imperative that each atom split by a neutron from the beryllium target should cause the splitting of many more.

It was equally imperative that this chain of reactions should always tend to dampen, to die out. It must not build up, or the uranium mass would explode within a time interval too short to be measured by any means whatsoever.

Nor would there be anyone left to measure it.

The atomic engineer on duty at the pile could control this reaction by means of the "trigger", a term the engineers used to include the linear resonant accelerator, the beryllium target, the cadmium damping rods, and adjacent controls, instrument board, and power sources. That is to say he could vary the bombardment on the beryllium target to increase or decrease the level of operation of the plant, he could change the "effective mass" of the pile with the cadmium dampers, and he could tell from his instruments that the internal reaction was dampened-or, rather, that it had been dampened the split second before. He could not possibly know what was actually happening now within the pile-subatomic speeds are too

great and the time intervals too small. He was like the bird that flew backward; he could see where he had been, but never knew where he was going.

Nevertheless, it was hisresponsibility, and his alone, not only to maintain the pile at a high efficiency, but to see that the reaction never passed the critical point and progressed into mass explosion.

But that was impossible. He could not be sure; he could never be sure.

He could bring to the job all of the skill and learning of the finest technical education, and use it to reduce the hazard to the lowest mathematical probability, but the blind laws of chance which appear to rule in sub-atomic action might turn up a royal flush against him and defeat his most skillful play.

And each atomic engineer knew it, knew that he gambled not only with his own life, but with the lives of countless others, perhaps with the lives of every human being on the planet. Nobody knew quite what such an explosion would do. A conservative estimate assumed that, in addition to destroying the plant and its personnel completely, it would tear a chunk out of the populous and heavily traveled Los Angeles-Oklahoma Road-City a hundred miles to the north.

The official, optimistic viewpoint on which the plant had been authorized by the Atomic Energy Commission was based on mathematics which predicted that such a mass of uranium would itself be disrupted on a molar scale, and therebylimit the area of destruction, before progressive and accelerated atomic explosion could infect the entire mass.

The atomic engineers, by and large, did not place faith in the official theory. They judged theoretical mathematical prediction for what it was worth-precisely nothing, until confirmed by experiment.

But even from the official viewpoint, each atomic engineer while on watch carried not only his own life in his hands, but the lives of many others-how many, it was better not to think about. No pilot, no general, no surgeon ever carried such a daily, inescapable, ever present weight of responsibility for the lives of others as these men carried every time they went on watch, every time they touched a venire screw, or read a dial.

They were selected not alone for their intelligence and technical training, but quite as much for their characters and sense of social responsibility. Sensitive men were needed-men who could fully appreciate the importance of the charge entrusted to them; no other sort would do. But the burden of responsibility was too great to be borne indefinitely by a sensitive man.

It was, of necessity, a psychologically unstable condition. Insanity was an occupational disease.

Doctor Cummings appeared, still buckling the straps of the armor worn to guard against stray radiation. "What's up?" he askedSilard .

"I had to relieve Harper."

"So I guessed. I met him coming up. He was sore as hell-just glared at me."

"I know. He wants an immediate hearing. That's why I had to send for you."

Cummings grunted,then nodded toward the engineer, anonymous in all-enclosing armor. "Who'd I draw?"

"Erickson."

"Good enough.Squareheads can't go crazy-eh, Gus?"

Erickson looked up momentarily, and answered, "That's your problem," and returned to his work. Cummings turned back toSilard , and commented, "Psychiatrists don't seem very popular around here. O.K.-I relieve you, sir."

"Very well, sir."

Silardthreaded his way through thezig-zag in the outer shield which surrounded the control room. Once outside this outer shield, he divested himself of the cumbersome armor, disposed of it in the locker room provided, and hurried to a lift. He left the lift at the tube station, underground, and looked around for an unoccupied capsule. Finding one, he strapped himself in, sealed thegasketed door, and settled the back of his head into the rest against the expected surge of acceleration.

Five minutes later he knocked at the door of the office of the general superintendent, twenty miles away.

The breeder plant proper was located in a bowl of desert hills on the Arizona plateau.Everything not necessary to the immediate operation of the plant-administrative offices, television station, and so forth-lay beyond the hills. The buildings housing these auxiliary functions were of the most durable construction technical ingenuity could devise. It was hoped that, if the tag ever came, occupants would stand approximately the chance of survival of a man going over Niagara Falls in a barrel.

Silardknocked again. He was greeted by a male secretary, Steinke.Silard recalled reading his case history. Formerly one of the most brilliant of the young engineers, he had suffered a blanking out of the ability to handle mathematical operations. A plain case of fugue, but there had been nothing that the poor devil could do about it- he had been anxious enough with his conscious mind to stay on duty. He had been rehabilitated as an office worker.

Steinke ushered him into the superintendent's private office. Harper was there before him, and returned his greeting with icy politeness. The superintendent was cordial, butSilard thoughthe .looked tired, as if the twenty-four-hour-a-day strain was too much for him.

"Come in, Doctor, come In. Sit down.Now.tell me about this. I'm a little' surprised. I thought Harper was one of my steadiest men."

"I don't say he isn't, sir."

"Well?"

"He may be perfectly all right, but your instructions to me are not to take any chances."

"Quite right" The superintendent gave the engineer, silent and tense in his chair, a troubled glance,then returned his attention toSilard . "Suppose you tell me about it."

Silardtook a deep breath. "While on watch as psychological observer at the control station I noticed that the engineer of the watch seemed preoccupied and less responsive to stimuli than usual. During my off-watch observation of this case, over a period of the past several days, I have suspected an increasing lack of attention. For example, while playing contract bridge, he now occasionally asks for a review of

the bidding which is contrary to his former behavior pattern.

"Other similar data are available. To cut it short, at 3:11 today, while on watch, I saw Harper, with no apparent reasonable purpose in mind, pick up a wrench used only for operating the valves of the water shield and approach the trigger. I relieved him of duty, and sent him out of the control room."

"Chief!"Harper calmed himself somewhat and continued, "If this witch-doctor knew a wrench from an oscillator, he'd know what I was doing. The wrench was on the wrong rack. I noticed it, and picked it up to return it to its proper place. On the way, I stopped to check the readings!"

The superintendent turned inquiringly to Doctor Shard. "That may be true- Granting that it is true," answered the psychiatrist doggedly, "my diagnosis still stands. Your behavior pattern has altered; your present actions are unpredictable, and I can't approve you for responsible work without a complete check-up."

General Superintendent King drummed on the desktop, and sighed. Then he spoke slowly to Harper, "Cal, you're a good boy, and believe me, I know how you feel. But: there is no way to avoid it-you've got to go up for thepsychometricals , and accept whatever disposition the board makes of you." He paused, but Harper maintained an expressionless silence. "Tell you what, son-why don't, you take a few days' leave? Then, when you come back,' you can go up before the board, or transfer to another department away from the bomb, whichever you prefer." He looked to Shard for approval, and received a nod.

But Harper was not mollified. "No, chief," he protested. "It won't do. Can't you' see what's wrong? It's this constant supervision.Somebody always watching the back of your neck, expecting you to go crazy. A man can't even shave in private. We're jumpy about the most innocent acts, for fear some head doctor, half batty himself, will see it and decide it's a sign we're slipping-good grief, what do you expect!"

His outburst having run its course, he subsided into a flippant cynicism that did" not quite jell. "O.K.-nevermind the strait jacket; I'll go quietly. You're a good Joe in spite of it, chief," he added, "and I'm glad to have worked under you. Goodbye."

King kept the pain in his eyes out of his voice. 'Wait a minute, Cal-you're not through here. Let's forget about the vacation.' I'm transferring you to the radiation laboratory. You belong in research anyhow; I'd never have spared you from it to stand watches if I hadn't been short on number-one men.

"As for the constant psychological observation, I hate it as much as you do. I don't suppose you know that they watch me about twice as hard as they watch you duty engineers."

Harper showed his surprise, but Shard nodded in sober conflation. "But we have to have this supervision. . . Do you remember Manning? No, he was before your time. We didn't have' psychological observers then. Manning was able and brilliant. Furthermore, he was always cheerful; nothing seemed to bother him.

"I was glad to have him on the pile, for he was always alert, and never seemed nervous about working with it-in fact he grew more buoyant and cheerful the longer he stood control watches. I should have known that was a very bad sign, but I didn't, and there was no observer to 'tell me so.

"His technician had to slug him one night. . . He found him dismounting the, safety interlocks on the cadmium assembly. Poor old Manning never pulled out of it- he's been violently insane ever since. After Manning cracked up, we worked out the present system of two qualified engineers and an observer for

every watch. It seemed the only thing to do."

"I suppose so, chief," Harper mused, his face no longer sullen, but still unhappy. "It's a hell of a situation just the same."

"That's putting it mildly." He got up and put out his hand. "Cal, unless you're dead set on leaving us, I'll expect to see you at the radiation laboratory tomorrow. Another thing-I don't often recommend this, but it might do you good to get drunk tonight."

King had signed to Shard to remain after the young man left. Once the door was closed he turned back to the psychiatrist. "There goes another one-and one of the best. Doctor, what am I going to do?"

Silardpulled at his cheek. "I don't know," he admitted. "The hell of it is,Harper's absolutely right. It does increase the strain on them to know that they are being watched... and yet they have to be watched. Your psychiatric staff isn't doing too well, either. It makes us nervous to be around the Big Bomb... the more so because we don't understand it. And it's a strain on us to be hated and despised as we are. Scientific detachment is difficult under such conditions; I'm getting jumpy myself."

King ceased pacing the floor and faced the doctor. "But there must be some solution-" he insisted.

Silardshook his head. "It's beyond me, Superintendent. I see no solution from the standpoint of psychology."

"No?Hmm-Doctor, who is the top man in your field?" "Eh?"

"Who is the recognized number-one man in handling this sort of thing?"

"Why, that's hard to say. Naturally, there isn't any one, leading psychiatrist in the world; we specialize too much." I know what you mean, though. You don't want the best industrial temperament psychometrician ; you want the" best all-around man for psychoses non-lesionaland situational. That would be Lentz."

"Go on."

"Well- He covers the whole field of environment adjustment. He's the man that correlated the theory of optimum tonicity with the relaxation technique thatKorzybski had developed empirically. He actually workedunder,Korzybski himself, when he was a young student-it's the only thing he's vain about."

"He did? Then he must be pretty old;Koxzybski died in- What year did he die?"

"I started to say that you must know his work insymbology -theory of abstraction and calculus of statement, all that sort of thing-because of its applications to engineering and mathematical physics."

"That Lentz-yes, of course.But I had never thought of him as a psychiatrist."

"No, you wouldn't, in your field. Nevertheless, we are inclined to credit him with having done as much to check and reduce the pandemic neuroses of the Crazy Years as any other man, and more than any man left alive."

"Where is he?"

"Why, Chicago, I suppose.At the Institute."

"Get him here."

"Get him down here. Get on thatvisiphone and locate him. Then have Steinke call the Port of Chicago, and hire astratocar to stand by for him. I want to see him as soon as possible-before the day is out." King sat up in his chair with the air of a man who is once more master of himself and the situation. His spirit knew that warming replenishment that comes only with reaching a decision. The harassed expression was gone.

Silardlooked dumbfounded. "But, superintendent," he expostulated, "you can't ring for Doctor Lentz as if he were a junior clerk. He's-he's Lentz."

"Certainly-that's why I want him. But I'm not a neurotic clubwoman looking for sympathy, either. He'll come. If necessary, turn on the heat from Washington. Have the White House call him. But get him here at once.Move!" King strode out of the office.

When Erickson came off watch he inquired around and found that Harper had left for town. Accordingly, he dispensed with dinner at the base, shifted into "drinkin'clothes", and allowed himself to be dispatched via tube to Paradise. Paradise, Arizona, was a hard little boom town, which owed its existence to the breeder plant. It was dedicated exclusively to the serious business of detaching the personnel of the plant from their inordinate salaries. In this worthy project they received much cooperation from the plant personnel themselves, each of whom was receiving from twice to ten times as much money each payday as he had ever received in any other job, and none of whom was certain of living long enough to justify saving for old' age. Besides, the company carried a sinking fund in Manhattan for their dependents; why be stingy?

It was claimed, with some truth, that any entertainment or luxury obtainable in New York City could be purchased in Paradise. The local chamber of commerce had appropriated the slogan of Reno, Nevada, "Biggest Little City in the World." The Reno boosters retaliated by claiming that, while a town that close to the atomic breeder plant undeniably brought thoughts of death and the hereafter; Hell's Gates would be a more appropriate name.

Erickson started making the rounds. There were twenty-seven places licensed to sell liquor in the six blocks of the main street of Paradise. He expected to find Harper in one of them, and, knowing the man's habits and tastes, he expected to find him in the first two three he tried.

He was not mistaken. He found Harper sitting alone a table in the rear ofdeLancey's SansSouci Bar. Lancey's was a favorite of both of them. There was old-fashioned comfort about its chrome-plated bar red leather furniture that appealed to them more than the spectacular fittings of the up-to-the-minute place.DeLancey was conservative; he stuck to indirect light and soft music; his hostesses were required to be fully clothed, even in the evening. The fifth of Scotch in front of Harper was about two thirds full. Erickson shoved three fingers in front Harper's face and demanded, "Count!"

"Three," announced Harper. "Sit down, Gus."

"That's correct," Erickson agreed, sliding his big frame into a low-slung chair. "You'll do-for now. What the outcome?"

"Have a drink. Not," he went on, "that this Scotch any good. I think Lance has taken to watering it. I surrendered, horse and foot."

"Lance wouldn't do that-stick to that theory anti you'll sink in the sidewalk up to your knees. How come you capitulated? I thought you planned to beat 'emabout the head and shoulders, at least." ' I

"I did," mourned Harper, "but, cripes, Gus, the chief is right. If a brain mechanic says you're punchy, he has got to back him up, and take you off the watch list. The chief can't afford to take a chance."

"Yeah, the chief's all right, but I can't learn to love our dear psychiatrists. Tell you what-let's find us one, and, see if he can feel pain. I'll hold him while you slug 'im."

"Oh, forget it, Gus. Have a drink."

"A pious thought-but not Scotch.I'm going to have a martini; we ought to eat pretty soon."

"I'll have one, too."

"Do you good." Erickson lifted his blond head and bellowed, "Israfell"

A large, black person appeared at his elbow. "MistuhErickson! Yes, sub!"

"Izzy, fetch two martinis.Make mine with Italian." He turned back to Harper. "What are you going to do now, Cal?"

"Radiation laboratory."

"Well, that's not so bad. I'd like to have a go at the matter of rocket fuels 'myself. I've got some ideas."

Harper looked mildly amused. "You mean atomic fuel for interplanetary flight? That problem's pretty well exhausted. No, son, the ionosphere is the ceiling until we think up something better than rockets. Of course, you could mount a pile in a ship, and figure out some jury rig to convert some of its output into push, but where does that get you? You would still have a terrible mass-ratio because of the shielding and I'm betting you couldn't convert one percent into thrust. That's disregarding the question of getting the company to lend you a power pile for anything that doesn't pay dividends."

Erickson looked balky. "I don't concede that you've covered all the alternatives. What have we got? The early rocket boys went right ahead trying to build better rockets, serene in the belief that, by the time they could build rockets good enough to fly to the moon, a fuel would be perfected that would do the trick. And they did build ships that were good enough-you could take any ship that makes the Antipodes run, and refit it for the moon-if you had a fuel that was adequate. But they haven't got it.

"And why not?Because we let 'emdown, that's why.Because they're still depending on molecular energy, on chemical reactions, with atomic power sitting right here in our laps. It's not their fault-old D. D. Harriman had Rockets Consolidated underwrite the whole first issue of Antarctic Pitchblende, and took a big slice of it himself, in the expectation that we would produce something usable in the way of a concentrated rocket fuel. Did we do it? Like hell! The company went hog-wild for immediate commercial exploitation, and there's no atomic rocket fuel yet."

"But you haven't stated it properly," Harper objected. "There are just two forms of atomic power-available, radioactivity and atomic disintegration. The first is too slow; the energy is there, but you can't wait years for it to come out-not in a rocket ship.The second we can only manage in a large power

plant.There you are-stymied."

"We haven't really tried," Erickson answered. "The power is there; we ought to give 'ema decent fuel"

"What would you call a 'decent fuel'?"

Erickson ticked it off. "A small enough critical mass so that all, or almost all, the energy could be taken up as heat by the reaction mass-I'd like the reaction mass to be ordinary water. Shielding that would have to be no more than a lead and cadmium jacket. And the whole thing controllable to a fine point."

Harper laughed. "Ask for Angel's wings and be done with it. You couldn't store such fuel in a rocket; it would~Set itself off before it reached the jet chamber."

Erickson's Scandinavian stubbornness was just gathering for another try at the argument when the waiter arrived with the drinks. He set them down with a triumphant flourish. "There youare,suh !"

"Want to roll for them,Izzy ?" Harper inquired.

"Don' mind if I do."

The Negro produced a leather dice cup and Harper rolled. He selected his combinations with care and managed to get four aces and jack in three rolls.Israfel took the cup. He rolled in the grand manner with a backwards twist to his wrist. His score finished at five kings, and he courteously accepted the price of six drinks. Harper stirred the engraved cubes with his forefinger.

"Izzy," he asked, "are these the same dice I rolled with?"

"Why,Mistuh Harper!" The black's expression was pained.

"Skip it," Harper conceded. "I should know better than to gamble with you. I haven't won a roll from you in six weeks. What did you start to say, Gus?"

"I was just going to say that there ought to be a better way to get energy out of-" But they were joined again, this time by something very seductive in an evening gown that appeared to have been sprayed on her lush figure. She was young, perhaps nineteen or twenty. "You boys lonely?" she asked as she flowed into a chair.

"Nice of you to ask, but we're not," Erickson denied with patient politeness. He jerked a thumb at a solitary figure seated across the room. "Go talk toHannigan ; he's not busy."

She followed his gesture with her eyes, and answered with faint scorn, "Him? He's no use. He's been like that for three weeks-hasn't spoken to a soul. If you ask me, I'd say that he was cracking up."

"That so?" he observed noncommittally. "Here-" He fished out a five-dollar bill and handed it to her. "Buy yourself a drink. Maybe we'll look you up later."

"Thanks, boys."The money disappeared under her clothing, and she stood up. "Just ask for Edith."

"Hannigandoes look bad," Harper considered, noting the brooding stare and apathetic attitude, "and he has been awfully stand-offish lately, for him. Do you suppose we're obliged to report him?"

"Don't let it worry you," advised Erickson, "there'sa spotter on the job now. Look." Harper followed his companion's eyes and recognized Dr. Mott of the psychological staff. He was leaning against the far end of the bar and nursing a tall glass, which gave him protective coloration. But his stance was such that his field of vision included not onlyHannigan , but Erickson and Harper as well.

"Yeah, and he's studying us as well," Harper added.' "Damn it to hell, why does it make my back hair rise just to lay eyes on one of them?"

The question was rhetorical, Erickson ignored it. "Let's get out of here," he suggested, "and have dinner some where else."

"O.K."

DeLanceyhimself waited on them as they left. "Going so soon, gentlemen?" he asked, in a voice that implied that their departure would leave him no reason to stay open."Beautiful lobsterthermidor tonight. If you do not like it, you need not pay." He smiled brightly.

"No sea food, Lance," Harper told him, "not tonight. Tell me-why do you stick around here when you know that the pile is bound to get you in the long run? Aren't you afraid of it?"

The tavern keeper's eyebrows shot up."Afraid of this pile? But it is my friend!"

"Makes you money, eh?"

"Oh, I do not mean that." He leaned toward them confidentially. "Five years ago I come here to make some money quickly for my family before my cancer of the stomach, it kills me. At the clinic, with the wonderful newradiants you gentlemen make with the aid of the Big Bomb, I am cured-I live again. No, I am not afraid of the pile; it is my good friend."

"Suppose it blows up?"

"When the good Lord needs me, he will take me." He crossed himself quickly.

As they turned away, Erickson commented in a low voice to Harper. "There's your answer, Cal-if all us engineers had his faith, the job wouldn't get us down."

Harper was unconvinced. "I don't know," be mused. 'I don't thinkit's faith; I think it's lack of imagination and knowledge."

Notwithstanding King's confidence, Lentz did not show up until the next day. The superintendent was subconsciously a little surprised at his visitor's appearance. He had pictured a master psychologist as wearing flowing hair, an imperial, and having piercing black eyes. But this man was not overly tall, was heavy in his framework, and fat-almost gross. He might have been a butcher. Little, piggy, faded-blue eyes peered merrily out from beneath shaggy blond brows. There was no hair anywhere else on the enormous skull, and the ape-like jaw was smooth and pink. He was dressed in mussed pajamas of unbleached linen. A long cigarette holder jutted permanently from one corner of a wide mouth, widened still more by a smile which suggestedunmalicious amusement at the worst that life, or men, could do. He had gusto. King found him remarkably easy to talk to.

At Lentz' suggestion the Superintendent went first into the history of atomic power plants, how the

fission of the uranium atom by Dr. Otto Hahn in December, 1938, had opened up the way to atomic power. The door was opened just a crack; the process to be self perpetuating and commercially usable required an enormously greater knowledge than there was available in the entire civilized world at that time.

In 1938 the amount of separated uranium-235 in the world was not the mass of the head of a pin. Plutonium was unheard of. Atomic power was abstruse theory and a single, esoteric laboratory experiment. World War II, the Manhattan Project, and Hiroshima changed that; by late 1945 prophets were rushing into print with predictions of atomic power, cheap, almost free atomic power, for everyone in a year or two.

It did not work out that way. The Manhattan Project had been run with the single-minded purpose of making weapons; the engineering of atomic power was still in the future.

The far future, so it seemed. The uranium piles used to make the atom bomb were literally no good for commercial power; they were designed to throw away power as a useless byproduct, nor could the design of a pile, once in operation, be changed. A design-on paper-for an economic, commercial power pile could be made, but it had two serious hitches. The first was that such a pile would give off energy with such fury, if operated at a commercially satisfactory level, that there was no known way of accepting that energy and putting it to work.

This problem was solved first. A modification of the Douglas-Martin power screens, originally designed to turn the radiant energy of the sun (a natural atomic power pile itself) directly into electrical power, was used to receive the radiant fury of uranium fission and carry it away as electrical current.

The second hitch seemed to be no hitch at all. An "enriched" pile-onein which U-235 or plutonium had been added to natural uranium-was a quite satisfactory source of commercial power. We knew how to get U-235 and plutonium; that was the primary accomplishment of the Manhattan Project.

Or did we know how? Hanford produced plutonium; Oak Ridge extracted U-235, true-but the Hanford piles used more U-235 than they produced plutonium and Oak Ridge produced nothing but merely separated out the 7/10 of one percent of U-235 in natural uranium and "threw away" the 99%-plus of the energy which was still locked in the discarded U-238. Commercially ridiculous, economically fantastic!

But there was another way to breed plutonium, by means of a high-energy,unmoderated pile of natural uranium somewhat enriched. At a million electron volts or more U-238 will fission at somewhat lower energies it turns to plutonium. Such a pile supplies its own "fire" and produces more "fuel" than it uses; it could breed fuel for many other power piles of the usual moderated sort.

But anunmoderated power pile is almost by definition an atom bomb.

The very name "pile" comes from the pile of graphite bricks and uranium slugs set up in a squash court at the University of Chicago at the very beginning of the Manhattan Project. Such a pile, moderated by graphite or heavy water, cannot explode.

Nobody knew what anunmoderated , high-energy pile might do. It would breed plutonium in great quantities- but would it explode? Explode with such violence as to make the Nagasaki bomb seem like a popgun?

Nobody knew.

In the meantime the power-hungry technology of the United States grew still more demanding. The Douglas Martinsunpower screens met the immediate crisis when oil became too scarce to be wasted as fuel, butsunpower was limited to about one horsepower per square yard and was at the mercy of the weather.

Atomic power was needed-demanded.

Atomic engineers lived through the period in an agony of indecision. Perhaps a breeder pile could be controlled. Or perhaps if it did go out of control it would simply blow itself apart and thus extinguish its own fires. Perhaps it would explode like several atom bombs but with low efficiency. But it might-it just might-explode its whole mass of many tons of uranium at once and destroy the human race in the process.

There is an old story, not true, which tells of a scientist who had made a machine which would instantly destroy the world, so he believed, if he closed one switch. He wanted to know whether or not lie was right. So he closed the switch-and never found out.

The atomic engineers were afraid to close the switch.

"It wasDestry's mechanics of infinitesimals that showed a way out of the, dilemma," King went on. "His equations appeared to predict that such an atomic explosion, once started, would disrupt the molar mass enclosing it so rapidly that neutron loss through the outer surface of the fragments would dampen the progression of the atomic explosion to zero before complete explosion could be reached. In an atom bomb such damping actually occurs.

"For the mass we use in the pile, his equations predicted possible force of explosion one-seventh of one percent of the force of complete explosion. That alone, of course, would be incomprehensibly destructive-enough to wreck this end of the state. Personally, I've never been sure that is all that would happen."

"Then why did you accept this job?" inquired Lentz.

King fiddled with items on his desk before replying. "I couldn't turn it down, doctor I couldn't. If I had refused, they would have gotten someone else-and it was an opportunity that comes to a physicist once in history."

Lentz nodded. "And probably they would- have gotten someone not as competent. I understand, Dr. King-you were compelled by the 'truth-tropism' of the scientist. He must go where the data is to be found, even if it kills him. But about this fellowDestry , I've never liked his mathematics; he postulates too much."

King looked up in quick surprise,then recalled that this was the man who had refined and given rigor to the calculus of statement. "That's just the hitch," he agreed. "His work is brilliant, but I've never been sure that his predictions were worth the paper they were written on. Nor, apparently," he added bitterly, "do my junior engineers."

He told the psychiatristOf the difficulties they had had with personnel, of how the most carefully selected men would, sooner or later, crack under the strain. "At first I thought it might be some degenerating effect from the neutron radiation that leaks out through the shielding, so we improved the screening and the personal armor. But it didn't help. One young fellow who had joined us after the new

screening was installed became violent at dinner one night, and insisted that a pork chop was about to explode. I hate to think of what might have happened if he had been on duty at the pile when he blew up."

The inauguration of the system of constant psychological observation had greatly reduced the probability of acute danger resulting from a watch engineer cracking up, but King was forced to admit that the system was not a success; there had actually been a marked increase in psychoneuroses, dating from that time.

"And that's the picture, Dr. Lentz. It gets worse all the time. It's getting me now. The strain is telling on me; I can't sleep, and I don't think my judgment is as good as it used to be-I have trouble making up my mind, of coming to a decision. Do you think you can do anything for us?"

But Lentz had no immediate relief for his anxiety. "Not so fast, superintendent," he countered. "You have given me the background, but I have no real data as yet. I must look around for a while, smell out the situation for myself, talk to your engineers, perhaps have a few drinks with them, and get acquainted. That is possible, is it not? Then in a few days, maybe, we know where we stand."

King had no alternative but to agree.

"And it is well that your young men do not know what I am here for. Suppose I am your old friend, a visiting physicist, eh?"

"Why, yes-of course. I can see to it that that idea gets around. But say-" King was reminded again of something that had bothered him from the timeSilard had first suggested Lentz' name. "May I ask a personal question?"

The merry eyes were undisturbed. "Go ahead."

"I can't help but be surprised that one man should attain eminence in two such widely differing fields as psychology and mathematics. And right now I'm perfectly convinced of your ability to pass yourself off as a physicist. I don't understand it."

The smile was more amused, without being in the least patronizing, nor offensive. "Same subject," he answered.

"Eh? How's that-"

"Or rather, both mathematical physics and psychology are branches of the same subject,symbology . You are a specialist; it' would not necessarily come to your attention."

"I still don't follow you."

"No? Man lives in a world of ideas. Any phenomenon is so complex that he cannot possibly grasp the whole of it. He abstracts certain characteristics of a given phenomenon as an idea, then represents that idea as a symbol, be it a word or a mathematical sign. Human reaction is almost entirely reaction to symbols, and only negligibly to phenomena. As a matter Of fact," he continued, removing the cigarette holder from his mouth and settling into his subject, "it can be demonstrated that the human mind can think only in terms of symbols.

"When we think, we let symbols operate on other symbols in certain, set fashions-rules of logic, or

rules of mathematics. If the symbols have been abstracted so that they are structurally similar to the phenomena they stand for, and if the symbol operations are similar in structure and order to the operations of phenomena in the ~real~ world, we think sanely. If our logic-mathematics, or our word-symbols,have been poorly chosen, we think not sanely.

"In mathematical physics you are concerned with making yoursymbology fit physical phenomena. In psychiatry I am concerned with precisely the same thing, except that I am more immediately concerned with the man who does the thinking than with the phenomena he is thinking about. But the same subject, always the dame subject."

"We're not getting anyplace, Gus." Harper put down his slide rule and frowned.

"Seems like it, Cal," Erickson grudgingly admitted.

"Damn it, though-there ought to be some reasonable way of tackling the problem. What do we need? Some form of concentrated, controllable power for rocket fuel. What have we got?Power galore through fission. There must be some way to bottle that power, and serve it out when we need it-and the answer is some place in one of the radioactive~ series. I know it." He stared glumly around the laboratory as if expecting to find the answer written somewhere on the lead-sheathed walls.

"Don't be so down in the mouth about it. You've got me convinced there is an answer; let's figure out how to find it. In the first place the three natural radioactive series are out, aren't they?"

"Yes ... at least we had agreed that all that ground had been fully covered before."

"Okay; we have to assume that previous investigators have done what their notes show they have done-otherwise we might as well not believe anything, and start checking on everybody from Archimedes to date. Maybe that is indicated, but Methuselah himself couldn't carry out such an assignment. What have we got left?"

"Artificialradioactives ."

"All right.Let's set up a list of them, both those that have been made up to now, and those that might possibly be made in the future. Call that our group-or rather, field, if you want to be pedantic about definitions. There are a limited number of operations that can be performed on each member of the group, and on the members taken in combination. Set it up."

Erickson did so, using the curious curlicues of the calculus of statement. Harper nodded. "All right-expand it."

Erickson looked up after a few moments, and asked, "Cal, have you any idea how many terms there are in the expansion?"

"No. . .hundreds , maybe thousands, I suppose."

"You're conservative. It reaches four figures without considering possible newradioactives . We couldn't finish such a research in a century. He chucked his pencil down and looked morose.

Cal Harper looked at him curiously, but with sympathy. "Gus," he said gently, "the job isn't getting you, too, is it?"

"I don't think so. Why?"

"I never saw you so willing to give up anything before. Naturally you and I will never finish any such job, but at the very worst we will have eliminated a lot of wrong answers for somebody else. Look at Edison-sixty years of experimenting, twenty hours a day, yet he never found out the one thing he was most interested in knowing. I guess if he could take it, we can."

Erickson pulled out of his funk to some extent. "I suppose so," he agreed. "Anyhow, maybe we could work out some techniques for carrying a lot of experiments simultaneously."

Harper slapped him on the shoulder. "That's theol ' fight. Besides, we may not need to finish the research, or anything like it, to find a satisfactory fuel. The way I see it, there are probably a dozen, maybe a hundred, right answers. We may run across one of them any day. Anyhow, since you're willing to give me a hand with it in your off watch time, I'm game to peck away at it till hell freezes."

Lentz puttered around the plant and the administration center for severaldays, until he was known to everyone by sight He made himself pleasant and asked questions. He was soon regarded as a harmless nuisance, to be tolerated because he was a friend of the superintendent. He even poked his nose into the commercial power end of the plant, and had the radiation-to-electric-power sequence explained to him in detail. This alone would have been sufficient to disarm any suspicion that he might be a psychiatrist, for the staff psychiatrists paid no attention to the hard-bitten technicians of the power-conversion unit. There was no need to; mental instability on their part could not affect the pile, nor were they subject to the strain of social responsibility. Theirs was simply a job personally dangerous, a type of strain strong men have been inured to since the jungle.

In due course he got around to the unit of the radiation laboratory set aside for Calvin Harper's use. He rang the bell and waited. Harper answered the door, hisantiradiation helmet shoved back from his face like some grotesque sunbonnet. "What is it?" he asked. "Oh-it's you, Doctor Lentz. Did you want to see me?"

"Why, yes, and no," the older man answered, "I was just looking around the experimental station and wondered what you do in here. Will I be in the way?"

"Not at all.Come in. Gus!"

Erickson got up from where he had been fussing over the power leads to their trigger a modified betatron rather than a resonant accelerator. "Hello."

"Gus, this is Doctor Lentz-Gus Erickson."

"We've met," said Erickson, pulling off his gauntlet to shake hands. He had had a couple of drinks with Lentz in town and considered him a "nice old duck." "You're just between shows, but stick around and we'll start another run-not that there is much to see."

While Erickson continued with the set-up, Harper conducted Lentz around the laboratory, explaining the line of research they were conducting, as happy as a father showing off twins. The psychiatrist listened with one ear and made appropriate comments while he studied the young scientist for signs of the instability he had noted to be recorded against him.

"You see," Harper explained, oblivious to the interest in himself, "we are testing radioactive materials to see if we can produce disintegration of the sort that takes place in the pile, but in a minute, almost

microscopic, mass. If we are successful, we can use the breeder pile to make a safe, convenient, atomic fuel for rockets-or for anything else." He went on to explain their schedule of experimentation.

"I see," Lentz observed politely. "What element are you examiningnow "

Harper told him. "But it's not a case of examining one element-we've finished Isotope II of this element with negative results. Our schedule calls next for running the same test on Isotope V. Like this." He hauled out a lead capsule, and showed the label to Lentz. He hurried away to the shield around the target of thebetatron , left open by Erickson. Lentz saw that he had opened the capsule, and was performing some operation on it with 'a long pair of tongs in a gingerly manner, having first lowered his helmet. Then he closed and clamped the target shield.

"Okay, Gus?" he called out."Ready to roll?"

"Yeah, I guess so," Erickson assured him, coming around from behind the ponderous apparatus, and rejoining them. They crowded behind a thick metal and concrete shield that cut them off from direct sight of the set up.

"Will I need to put- on armor?" inquired Lentz.

"No," Erickson reassured him, "we wear it because we are around the stuff day in and day out. You just stay behind the shield and you'll be all right."

Erickson glanced at Harper, who nodded, and fixed his, eyes on a panel of instruments mounted behind the shield. Lentz saw Erickson press a push button at the top of the board,then heard a series of relays click on the far side of~ the shield. There was a short moment of silence.

The floor slapped his feet like some incredible bastinado. The concussion that beat on his ears was so intense that it paralyzed the auditory nerve almost before it could be recorded as sound. The air-conducted concussion wave flailed every inch of his body with a single, stinging, numbing blow. As he picked himself up, he found he was trembling uncontrollably and realized, for the first time, that he was getting old.

Harper was seated on the floor and had commenced to bleed from the nose. Erickson had gotten up, his cheek was cut. He touched a hand to the wound,then stood there, regarding the blood on his fingers with a puzzled expression on his face.

"Are you hurt?" Lentz inquired inanely. "What happened?"

Harper cut in. "Gus, we've done it! We've done it! Isotope Five has turned the trick!"

Erickson looked still more bemused. "Five?" he said stupidly, "-but that wasn't Five, that was Isotope IL I put it in myself."

"You put it in? I put it in! It was Five, I tell you!"

They stood staring at each other, still confused by the explosion, and each a little annoyed at the boneheaded stupidity the other displayed in the face of the obvious. Lentz diffidently interceded.

"Wait a minute, boys," he suggested, "maybe there's a reason-Gus,you placed a quantity of the second isotope in the receiver?"

"Why, yes, certainly. I wasn't satisfied with the last run, and I wanted to check it."

Lentz nodded. "It's my fault, gentlemen," he admitted ruefully. "I came in, disturbed your routine, and both of you charged the receiver. I know Harper did, for I saw him do it with Isotope V. I'm sorry."

Understanding broke over Harper's face, and he slapped the older man on the shoulder. "Don't be sorry," he laughed; "you can come around to our lab and help us make mistakes anytime you feel in the mood- Can't he, Gus? This is the answer, Doctor Lentz, this is it!"

"But," the psychiatrist pointed out, "you don't know which isotope blew up."

"Nor care," Harper supplemented. "Maybe it was both, taken together. But we will know-this business is cracked now; we'll soon have it open." He gazed happily around at the wreckage.

In spite of Superintendent King's anxiety, Lentz refused to be hurried in passing judgment on the situation. Consequently, when be did present himself at King's office, and announced that he was ready toreport, King was pleasantly surprised as well as relieved. "Well, I'm delighted," he said. "Sit down, doctor, sit down. Have a cigar. What do we do about it?"

But Lentz stuck to his perennial cigarette, and refused to be hurried. "I must have some information first: how important," he demanded, "is the power from your plant?"

King understood the implication at once. "If you are thinking about shutting down - the plant for more than a limited period, it can't be done."

"Why not?If the figures supplied me are correct, your power output is less than thirteen percent of the total power used in the country."

"Yes, that is true, but we also supply another thirteen percent second hand through the plutonium we breed here-and you haven't analyzed the items that make up the balance. A lot of it is domestic power which householders get from sunscreens located on their roofs. Another big slice is power for the moving roadways-that'ssunpower again. The portion we provide here directly or indirectly is the main power source for most of the heavy industries-steel, plastics,lithics , all kinds of manufacturing and processing. You might as well cut the heart out of a man-"

"But the food industry isn't basically dependent on you?" Lentz persisted.

"No ... Food isn't basically a power industry though we do supply a certain percentage of the power used in processing. I see your point, and will go on, concede that transportation, that is to say, distribution food, could get along without us. But good heavens, Doctor, you can't stop atomic power without causing the biggest panic this country has ever seen. It's the keystone our whole industrial system."

"The country has lived through panics before, and we got past the oil shortage safely."

"Yes becausesunpower and atomic power had to take the place of oil. You don't realize what would mean, Doctor. It would be worse than a war; in system like ours, one thing depends on another. If you cut off the heavy industries all at once, everything else stops too."

"Nevertheless, you had better dump the pile." The uranium in the pile was molten, its temperature bell

greater than twenty-four hundred degrees centigrade. The pile could be dumped into a group of small containers when it was desired to shut it down. The mass into one container would be too small to maintain progressive atomic disintegration.

Icing glanced involuntarily at the glass-enclosed relay mounted on his office wall, by which he, as well as the engineer on duty, could dump the pile, if need be. "But ~ couldn't do that ... or rather, if I did, the plant wouldn't stay shut down. The directors would simply replace me with someone who would operate it."

"You're right, of course." Lentz silently considered the situation for some time, then said, "Superintendent, will you order a car to fly me back to Chicago?"

"You're going, doctor?"

"Yes." He took the cigarette holder from his face, and, for once, the smile of Olympian detachment was gone completely. His entire manner was sober, even tragic.

"Short of shutting down the plant, there is no solution to your problem-none whatsoever!"

"I owe you a full explanation," he continued, presently.

"You are confronted here with recurring instances of situational psychoneurosis. Roughly, the symptoms manifest themselves as anxiety neurosis, or some form of hysteria.

The partial amnesia of your secretary, Steinke, is a good example of the latter. He might be cured with shock technique, but it would hardly be a kindness, as he has achieved a stable adjustment which puts him beyond the reach of the strain he could not stand.

"That other young fellow, Harper, whose blowup was the immediate cause of you sending for me, is an anxiety case. When the cause of the anxiety was eliminated from his matrix, he at once regained full sanity. But keep a close watch on his friend, Erickson- "However, it is the cause, and prevention, of situational psychoneurosis we are concerned with here, rather than the forms in which it is manifested. In plain language, psychoneurosis situational simply refers to the common fact that, if you put a man in a situation that worries him more than he can stand, in time he blows up, one way or another.

"That is precisely the situation here. You take sensitive, intelligent young men, impress them with the fact that a single slip on their part, or even some fortuitous circumstance beyond their control, will result in the death of God knows how many other people, and then expect them to remain sane. It's ridiculous-impossible!"

"But good heavens, doctor!-there must be some answer- There must!" He got up and paced around the room. Lentz noted, with pity, that King himself was riding the ragged edge of the very condition they were discussing.

"No," he said slowly. "No ... let me explain. You don't dare entrust control to less sensitive, less socially conscious men. You might as well turn the controls over to a mindless idiot. And to psychoneurosis situational there are but two cures. The first obtains when the psychosis results from a misevaluation of environment.That cure calls for semantic readjustment. One assists the patient to evaluate correctly his environment. The worry disappears because there never was a real reason for worry in the situation itself, but simply in the wrong meaning the patient's mind had assigned to it.

"The second case is when the patient has correctly evaluated the situation, and rightly finds in it cause for extreme worry. His worry is perfectly sane and proper, but he cannot stand up under it indefinitely; it drives him crazy. The only possible cure is to change the situation. I have stayed here long enough to assure myself that such is the condition here. You engineers have correctly evaluated the public danger of this thing, and it will, with dreadful certainty, drive all of you crazy!

"The only possible solution is to dump the pile-and leave it dumped."

King had continued his nervous pacing of the floor, as if the walls of the room itself were the cage of his dilemma. Now he stopped and appealed once more to the psychiatrist. "Isn't there anything I can do?"

"Nothing to cure.To alleviate-well, possibly."

"How?"

"Situational psychosis results from adrenalin exhaustion. When a man is placed under a nervous strain, his adrenal glands increase their secretion to help compensate for the strain. If the strain is too great and lasts too long, the adrenals aren't equal to the task, and he cracks. That is what you have here. Adrenalin therapy might stave of a mental breakdown, but it most assuredly would hasten a physical breakdown. But that would be safer from a viewpoint of public welfare-even though it assumes that physicists are expendable!

"Another thing occurs to me: If you selected any new watch engineers from the membership of churches that practice the confessional, it would increase the length of their usefulness."

King was plainly surprised. "I don't follow you."

"The patient unloads most of his worry on his confessor, who is not himself actually confronted by the situation, and can stand it. That is simply an ameliorative, however. I am convinced that in this situation, eventual insanity is inevitable. But there is a lot of good sense in the confessional," he mused. "It fills a basic human heed. I think that is why the early psychoanalysts were so surprisingly successful, for all their limited knowledge." He fell silent for a while,then added, "If you will be so kind as to order astratocab for me-"

"You've nothing more to suggest?'

"No. You had better turn your psychological staff loose on means of alleviation; they're able men, all of them."

King pressed a switch, and spoke briefly to Steinke. Turning back to Lentz, he said, "You'll wait here until your car is ready?"

Lentz judged correctly that King desired it, and agreed.

Presently the tube delivery on King's desk went "Ping!"

The superintendent removed a small white pasteboard, a calling card. He studied it with surprise and passed it over to Lentz. "I can't imagine why he should be calling on me," he observed, and added, "Would you like to meet him?"

Lentz read:

THOMAS P. HARRINGTON

Captain (Mathematics)

United States Navy

Director

U.S. Naval Observatory

"But I do know him," he said. "I'd be very pleased to see him."

Harrington was a man with something on his mind. He seemed relieved when Steinke had finished ushering him in and had returned to the outer office. He commenced to speak at once, turning to Lentz, who was nearer to him than King.

"You're King? Why, Doctor Lentz! What are you doing here?"

"Visiting," answered Lentz, accurately - but incompletely, as he shook hands. "This is Superintendent King over here. Superintendent King-Captain Harrington."

"How do you do, Captain-it's a pleasure to have you here."

"It's an honor to be here sir."

"Sit down?"

"Thanks." He accepted a chair, and laid a briefcase at a corner of King's desk. "Superintendent, you are entitle to an explanation as to why I have broken in on you Ilk this-"

"Glad to have you." In fact, the routine of formal politeness was an anodyne to King's frayed nerves.

"That's kind of you, but that secretary chap, the one that brought me in here, would it be too much to as for you to tell him to forget my name? I know it seem strange-"

"Not at all."King was mystified, but willing to grab any reasonable request of a distinguished colleague in science. He summoned Steinke to the interofficevisiphone and gave him his orders.

Lentz stood up, and indicated that he was about to leave. He caught Harrington's eye. "I think you want private palaver, Captain."

King looked from Harrington to Lentz, and back at Harrington. The astronomer showed momentary indecision,then protested, "I have no objection at all myself it's up to Doctor King. As a matter of fact," he added," might be a very good thing if you did sit in on it."

"I don't know what it is, Captain," observed Kin~ "that you want to see me about, but Doctor Lentz is a ready here in a confidential capacity."

"Good! Then that'ssettled .. I'll get right down I business. Doctor King, you knowDestry's mechanics infinitesimals?"

"Naturally."Lentz cocked a brow at King, who chose to ignore it.

"Yes, of course. Do you remember - theorem six,an the transformation between equations thirteen and fourteen?"

"I think so, but I'd want to see them." King got up and went over to a bookcase. Harrington stayed him with a hand.

"Don't bother. I have them here." He hauled out a key, unlocked his briefcase, and drew out a large, much thumbed, loose-leaf notebook. "Here.You, too, Doctor Lentz. Are you familiar with this development?"

Lentz nodded. "I've had occasion to look into them."

"Good-I think it's agreed that the step between thirteen and fourteen is the key to the whole matter. Now the change from thirteen to fourteen looks perfectly valid and would be, in some fields. But suppose we expand it to show every possible phase of the matter, every link in the chain of reasoning."

He turned a page, and showed them the same two equations broken down into nine intermediate equations. He placed a finger under an associated group of mathematical symbols. "Do you see that? Do you see what that implies?" He peered anxiously at their faces.

King studied it, his lips moving. "Yes... . I -believe I do see. 'Odd... I never looked at it just that way before- yet I've studied those equations until I've dreamed about them." He turned to Lentz. "Do you agree, Doctor?"

Lentz nodded slowly. "I believe so ... Yes, I think I may say so."

Harrington should have been pleased; he wasn't. "I had hoped you could tell me I was wrong," he said, almost petulantly, "but I'm afraid there is no further doubt about it. DoctorDestry included an assumption valid in molar physics, but for which we have absolutely no assurance in atomic physics. I suppose you realize what this means to you, Doctor King?"

King's voice was a dry whisper. "Yes," he said, "yes it means that if the Big Bomb out there ever blows up, we must assume that it will all go up all at once, rather than the wayDestry predicted ... and God help the human race!"

Captain Harrington cleared his throat to break the silence that followed. "Superintendent," he said, "I would not have ventured to call had it been simply a matter of disagreement as to interpretation of theoretical predictions-"

"You have something more to go on?"

"Yes,and no. Probably you gentlemen think of the Naval Observatory as being exclusively preoccupied with ephemeredes and tide tables. In a way you would be right-but we still have some time to devote to research as long as it doesn't cut into the appropriation. My special interest has always been lunar theory.

"I don't mean lunar ballistics," he continued, "I mean the much more interesting problem of its origin and history, the problem the younger Darwin struggled with, as well as my Illustrious predecessor, Captain T. J. J. See. I think that it is obvious that any theory of lunar origin and history must take into account the surface features of the moon-especially the mountains, the craters, that mark its face so prominently."

He paused momentarily, and Superintendent King put in, "Just a minute, Captain-I may be stupid, or perhaps I missed something, but-is there a connection between what we were discussing before and lunar theory?"

"Bear with me for a few moments, Doctor King," Harrington apologized; "there is a connection-at least, I'm afraid there is a connection-but I would rather present my points in their proper order before making my conclusions." They granted him an alert silence; he went on:

"Although we are in the habit of referring to the 'craters' of the moon, we know they are not volcanic craters. Superficially, they follow none of the rules of terrestrial volcanoes in appearance or distribution, but whenRutter came out in 952 with his monograph on the dynamics ofvulcanology , he proved rather conclusively that the lunar craters could not be caused by anything that we know as volcanic action.

"That left the bombardment theory as the simplest hypothesis. It looks good, on the face of it, and a few minutes spent throwing pebbles in to a patch of mud will convince anyone that the lunar craters could have been formed by falling meteors.

"But there are difficulties.If the moon was struck so repeatedly, why not the earth? It hardly seems necessary to mention that the earth's atmosphere would be no protection against masses big enough to form craters likeEndymion , or Plato. And if they fell after the moon was a dead world while the earth was still young enough to change its face and erase the marks of bombardment, why did the meteors avoid so nearly completely the dry basins we call the seas?

"I want to cut this short; you'll find the data and the mathematical investigations from the data here in my notes. There is one other major objection to the meteor bombardment theory: the great rays that spread from

Tychoacross almost the entire surface of the moon.It makes the moon look like a crystal ball that had been struck with ahammer, and impact from - outside seems evident, but there are difficulties. The striking mass, our hypothetical meteor, must have been smaller than the present crater ofTycho , but it must have the mass and speed to crack an entire planet."

"Work it out for yourself-you must either postulate a chunk out of the core of a dwarf star, or speeds such as we have never observed within the system. It's conceivable but a far-fetched explanation"

He turned to King. "Doctor, does anything occur to you that might account for a phenomenon like Tycho ?"

The Superintendent grasped the arms of his chair,then glanced at his palms. He fumbled for a handkerchief, and wiped them. "Go ahead," he said, almost inaudibly.

"Very well then-" Harrington drew out of his briefcase a large photograph of the moon-a beautiful full-moon portrait made at Lick. "I want you to imagine the moon as she might have been sometime in the past. The dark areas we call the 'Seas' are actual oceans. It has an atmosphere, perhaps a heavier gas

than oxygen and nitrogen, but an active gas, capable of supporting some conceivable form of life.

"For this is an inhabited planet, inhabited by intelligent beings, beings capable of discovering atomic power and exploiting it!"

He pointed out on the photograph, near the southern limb, the lime-white circle ofTycho , with its shining, incredible, thousand-mile-long rays spreading, thrusting,jutting out from it. "Here ... here atTycho was located their main atomic plant." He moved his finger to a point near the equator, and somewhat east of meridian-the point where three great dark areas merged, MareNubium , MareImbriwn , Oceanus Procellarum -and picked out two bright splotches surrounded also by rays, but shorter, less distinct, and wavy. "And here at Copernicus and atKepler , on islands at the middle of a great ocean, were secondary power stations."

He paused, and interpolated soberly, "Perhaps they knew the danger they ran, but wanted power so badly that they were willing to gamble the life of their race. Perhaps they were ignorant of the ruinous possibilities of their little machines, or perhaps their mathematicians assured them that it could not happen.

"But we will never know ... no one can ever know.For it blew up, and killed them-and it killed their planet.

"It whisked off the gassy envelope and blew it into outer space. It may even have set up a chain reaction, in that atmosphere. It blasted great chunks of the planet's crust Perhaps some of that escaped completely, too, but all that did not reach the speed of escape fell back down in time and splashed great ring-shaped craters in the land.

"The oceans cushioned the shock; only the more massive fragments formed craters through the water. Perhaps some life still remained in those ocean depths. If so, it was doomed to die-for the water, unprotected by atmospheric pressure, could not remain liquid and must inevitably escape lit time to outer space. Its life blood drained away. The planet was dead-dead by suicide!

He met the grave eyes of his two silent listeners with an expression almost of appeal. "Gentlemen-this is only a theory I realize ... only a theory, a dream, a nightmare- But it has kept me awake so many nights that I had to come tell you about it, and see if you saw it the same way I do.

As for the mechanics of it, it's all in there, in my notes. You can check it-and I pray that you find some error! But it is the only lunar theory I have examined which included all of the known data, and accounted for all of them."

He appeared to have finished; Lentz spoke up. "Suppose, Captain, suppose we check your mathematics and find no flaw-what then?"

Harrington flung out his hands. "That's what I came here to find out!"

Although Lentz had asked the question, Harrington directed the appeal to King. The superintendent looked up; his eyes met the astronomer's, wavered, and dropped again. "There's nothing to be done," he said dully, "nothing at all."

Harrington stared at him in open amazement. "But good God, man!" he burst out. "Don't you see it? That pile has got to be disassembled at once!"

"Take it easy, Captain." Lentz's calm voice was a spray of cold water. "And don't be too harsh on

poorKing, this worries him even more than it does you. What he means is this; we're not faced with a problem in physics, but with a political and economic situation. Let's put it this way: King can no more dump his plant than a peasant with a vineyard on the slopes of Mount Vesuvius can abandon his holdings and pauperize his family simply because there will be an eruption someday.

"King doesn't own that plant out there; he's only the custodian. If he dumps it against the wishes of the legal owners, they'll simply oust him and put in someone more amenable. No, we have to convince the owners."

"The President could make them do it," suggested Harrington. "I could get to the President-"

"No doubt you could, through your department. And you might even convince him. But could he help much?"

"Why, of course he could. He's the President!"

"Wait a minute. You're Director of the Naval Observatory; suppose you took a sledge hammer and tried to smash the big telescope-how far would you get?"

"Not very far," Farrington conceded. "We guard the big fellow pretty closely."

"Nor can the President act in an arbitrary manner," Lentz persisted. "He's not an unlimited monarch. If he shuts down this plant without due process of law, the federal courts will tie him in knots. I admit that Congress isn't helpless, since the Atomic Energy Commission takes orders from it, but-would you like to try to give a congressional committee a course in the mechanics of infinitesimals?"

Harrington readily stipulated the point. "But there is another way," he pointed out. "Congress is responsive to public opinion. What we need to do is to convince the public that the pile is a menace to everybody. That could be done without ever trying to explain things in terms of higher mathematics."

"Certainly it could," Lentz agreed. "You could go on the air with it and scare everybody half to death. You could create the damnedest panic this slightly slug-nutty country has ever seen. No, thank you. I, for one, would rather have us all take the chance of being quietly killed than bring on a mass psychosis that would destroy the culture we are building up. I think one taste of the Crazy Years is enough."

"Well, then, what do you suggest?"

Lentz considered shortly,then answered, "All I see is a forlorn hope. We've got to work on the Board of Directors and try to beat some sense in their heads."

King, who had been following the discussion with attention in spite of his tired despondency, interjected a remark. "How would you go about that?"

"I don't know," Lentz admitted. "It will take some thinking. But it seems the most fruitful line of approach. If it doesn't work, we can always fall back on Harrington's notion of publicity-I don't insist that the world commit suicide to satisfy my criteria of evaluation."

Harrington glanced at his wrist watch-a bulky affair-and whistled. "Good heavens," he exclaimed, "I forgot the time! I'm supposed officially to be at the Flag staff Observatory."

King had automatically noted the time shown by the Captain's watch as it was displayed. "But it can't

be that late," he had objected. Harrington looked puzzled,then laughed.

"It isn't-not by two hours. We are in zone plus-seven; this shows zone plus-five-it's radio-synchronized with the master clock at Washington."

"Did you say radio-synchronized?"

"Yes. Clever, isn't it?" He held it out for inspection. "I call it atelechronometer ; it's the only one of its sort to date. My nephew designed it for me. He's a bright one, that boy. He'll go far. That is"-his face clouded, as if the little interlude had only served to emphasize the tragedy that hung over them-"if any of us live that long!"

A signal light glowed at King's desk, and Steinke's face showed on the communicator screen. King answered him, then said, "Your car is ready, Doctor Lentz."

"Let Captain Harrington have it."

"Then you're not going back to Chicago?"

"No. The situation has changed. If you want me, I'm stringing along."

The following FridaySteinike ushered Lentz into King's office. King looked almost happy as he shook hands. "When did you ground, Doctor? I didn't expect you back for another hour, or so."

"Just now.I hired a cab instead of waiting for..theshuttle."

"Any luck?" King demanded.

"None.The same answer they gave you: 'The Company is assured by independent experts that Destry's mechanics is valid, and sees no reason to encouragean hysterical attitude among its employees."

King tapped on his desk top, his eyes unfocused. Then, hitching himself around to face Lentz directly, he said, "Do you suppose the Chairman is right?"

"How?"

"Could the three of us, you, me, and Harrington, have gone off the deep end, slipped mentally?"

"No."

"You're sure?"

"Certain. I looked up some independent experts of my own, not retained by the Company, and had them check Harrington's work. It checks." Lentz purposely neglected to mention that he had done so partly because he was none too sure of King's present mental stability.

King sat up briskly, reached out and stabbed a push button. "I am going to make one more try," he explained, "to see if I can't throw a scare into Dixon's thick head. Steinke," he said to the communicator, "get me Mr. Dixon on the screen."

"Yes, sir."

In about two minutes thevisiphone screen came to life and showed the features of Chairman Dixon. He was transmitting, not from his office, but from the boardroom of the power syndicate in Jersey City. "Yes?" he said.

"What is it, Superintendent?" His manner was somehow both querulous and affable.

"Mr. Dixon," King began, "I've called to try to impress on you the seriousness of the Company's action. I stake my scientific reputation that Harrington has proved completely-"

"Oh, that? Mr. King, I thought you understood that that was a closed matter."

"But Mr. Dixon-"

"Superintendent, please! If there was any possible legitimate cause to fear do you think I would hesitate? I have children you know, and grandchildren."

"That is just why-"

"We try to conduct the affairs of the Company with reasonable wisdom, and in the public interest. But we have other responsibilities, too. There are hundreds of thousands of little stockholders who expect us to show a reasonable return on their investment. You must not expect us to jettison a billion-dollar corporation just because you've taken up astrology.Moon theory!" He sniffed.

"Very well, Mister Chairman."King's tone was stiff.

"Don't,take it that way, Mr. King. I'm glad youcalled, the Board has just adjourned a special meeting. They have decided to accept you for retirement-with full pay, of course."

"I did not apply for retirement!"

"I know, Mr. King, but the Board feels that-"

"I understand. Goodbye!"

"Mr. King-"

"Goodbye!" He switched him off, and turned to Lentz. "'-with full pay,'" he quoted, "which I can enjoy in any way that I like for the rest of my life just as happy as a man in the death house!"

"Exactly," Lentz agreed. "Well, we've tried our way. I suppose we should call up Harrington now and let him try the political and publicity method."

"I suppose so," King seconded absent-mindedly. "Will you be leaving for Chicago now?"

"No . . ." said Lentz. "No.... I think I will catch the shuttle for Los Angeles and take the evening rocket for the Antipodes."

King looked surprised, but said nothing. Lentz answered the unspoken comment. "Perhaps some of us on the other side of the earth will survive. I've done all that I can here. I would rather be a live sheepherder in Australia than a dead psychiatrist in Chicago."

King nodded vigorously. "That shows horse sense. For two cents, I'd dump the pile now, and go with you."

"Not horse sense, my friend-a horse will run back into a burning barn, which is exactly what I plan not to do. Why don't you do it and come along. If you did, it would help Harrington to scare 'emto death."

"I believe I will!"

Steinke's face appeared again on the screen. "Harper and Ericksonare here, Chief."

"I'm busy."

"They are pretty urgent about seeing you."

"Oh-all right," King said in a tired voice, "show them in. It doesn't matter."

They breezed in, Harper in the van. He commenced talking at once, oblivious to the superintendent's morose preoccupation. "We've got it, Chief, we've got it! And it all checks out to the umpteenth decimal!"

"You've got what? Speak English."

Harper grinned. He was enjoying his moment of triumph, and was stretching it out to savor it. "Chief, do you remember a few weeks back when I asked for an additional allotment-a special one without specifying how I was going to spend it?"

"Yes. Come on-get to the point."

"You kicked at first, but finally granted it. Remember?

Well, we've got something to show for it, all tied up in pink ribbon. It's the greatest advance in radioactivity since Hahn split the nucleus.Atomic fuel, Chief, atomic fuel, safe, concentrated, and controllable. Suitable for rockets, for power plants, for any damn thing you care to use it for."

King showed alert interest for the first time. "You mean a power source that doesn't require a pile?"

"Oh, no, I didn't say that. You use the breeder pile to make the fuel, then you use the fuel anywhere and anyhow you like, with something like ninety-two percent recovery of energy. But you could junk the power sequence, if you wanted to."

King's first wild hope of a way out of his dilemma was dashed; he subsided. "Go ahead. Tell me about it."

"Well-it's a matter of artificialradioactives . Just before I asked for that special research allotment, Erickson and I-Doctor Lentz had a finger in it too," he acknowledged with an appreciative nod to the psychiatrist, "-found two isotopes that seemed to be mutually antagonistic. That is, when we goosed 'em in the presence of each other they gave up their latent energy all at once- blew all to hell. The important point is we were using just a gnat's whisker of mass of each-the reaction didn't require a big mass to maintain it."

"I don't see," objected King, "how that could-"

"Neither do we, quite-but it works. We've kept it quiet until we were sure. We checked on what we had, and we found a dozen other fuels. Probably we'll be able to tailor-make fuels for any desired purpose. But here it is." He handed him a bound sheaf of typewritten notes which he had been carrying under his arm. "That's your copy. Look it over."

King started to do so. Lentz joined him, after a look that was a silent request for permission, which Erickson had answered with his only verbal contribution, "Sure, doc."

As King read, the troubled feelings of an acutely harassed executive left him. His dominant personality took charge, that of the scientist. He enjoyed the controlled and cerebral ecstasy of the impersonal seeker for the elusive truth. The emotions felt in his throbbing thalamus were permitted only to form a sensuous obbligato for the cold flame of cortical activity. For the time being, he was sane, more nearly completely sane than most men ever achieve at any time.

For a long period there was only an occasional grunt, the clatter of turned pages, a nod of approval. At last he put it down.

"It's the stuff," he said. "You've done it, boys. It's great; I'm proud of you."

Ericksonglowed a bright pink, and swallowed. Harper's small, tense figure gave the ghost of a wriggle, reminiscent of a wire-haired terrier receiving approval. "That's fine, Chief. We'd rather hear you say that than get the Nobel Prize."

"I think you'll probably get it. However"-the proud light in his eyes died down-"I'm not going to take any action in this matter."

"Why not, Chief?"His tone was bewildered.

"I'm being retired. My successor will take over in the near future; this is too big a matter to start just before a change in administration."

"You beingretired! What the bell?"

"About the same reason I took you off watch-at least, the directors think so."

"But that's nonsense! You were right to take me off the watch-list; I was getting jumpy. But you're another matter-we all depend on you."

"Thanks, Cal-but that's how it is; there's nothing to be done about it." He turned to Lentz. "I think this is the last ironical touch needed to make the whole thing pure farce," he observed bitterly. "This thing is big, bigger than we can guess at this stage-and I have to give it a miss."

"Well," Harper burst out, "I can think of something to do about it!" He strode over to King's desk and snatched up the manuscript. "Either you superintend the exploitation, or the Company can damn well get along without our discovery!" Erickson concurred belligerently.

"Wait a minute." Lentz had the floor. "Doctor Harper... have you already achieved a practical rocket fuel?"

"I said so. We've got it on hand now."

"An escape-speed fuel?"They understood his verbal shorthand a fuel that would lift a rocket free of the earth's gravitational pull.

"Sure. Why, you could take any of the Clipper rockets, refit them a trifle, and have breakfast on the moon."

"Very well.Bear with me. . . ." He obtained a sheet of paper from King, and commenced to write. They watched in mystified impatience. He continued briskly for some minutes, hesitating only momentarily. Presently he stopped, and spun the paper over to King. "Solve it!" he demanded.

King studied the paper. Lentz had assigned symbols to a great number of factors, some social, some psychological, some physical, some economic. He had thrown them together into a structural relationship, using the symbols of calculus of statement. King understood theparamathematical operations indicated by the symbols, but he was not as used to them as he was to the symbols and operations of mathematical physics. He plowed through the equations, moving his lips slightly in subconscious vocalization.

He accepted a pencil from Lentz, and completed the solution. It required several more lines, a few more equations, before they cancelled out, or rearrangedthemselves , into a definite answer.

He stared at this answer while puzzlement gave way to dawning comprehension and delight.

He looked up. "Erickson! Harper!" he rapped out.

"We will take your new fuel, refit a large rocket, install the breeder pile in it, and throw it into an orbit around the earth, far out in. space. There we will use it to make more fuel, safe fuel, for use on earth, with the danger from the Big Bomb itself limited to the operators actually on watch!"

There was no applause. It was not that sort of an idea; their minds were still struggling with the complex implications.

"But Chief," Harper finally managed, "how about your retirement? We're still not going to stand for it."

"Don't worry," King assured him. "It's all in there, implicit in those equations, you two, me, Lentz, the Board of Directors and just what we all have to do about it to accomplish it."

"All except the matter of time," Lentz cautioned.

"You'll note that elapsed time appears in your answer as an undetermined unknown."

"Yes.. .yes, of course. That's the chance we have to take. Let's get busy!"

Chairman Dixon called the Board of Directors to order. "This being a special meeting we'll dispense with minutes and reports," he announced. "As set forth in the call we have agreed to give the retiring superintendent two hours of our time."

"Mr. Chairman-"

"Yes, Mr. Strong?"

"I thought we had settled that matter."

"We have, Mr. Strong, but in view of Superintendent King's long and distinguished service, if he asks for a hearing, we are honor bound to grant it. You have the floor, Doctor King."

King got up, and stated briefly, "Doctor Lentz will speak for me." He sat down.

Lentz had to wait for coughing, throat-clearing, and scraping of chairs to subside. It was evident that the Board resented the outsider.

Lentz ran quickly over the main points in the argument which contended that the bomb presented an intolerable danger anywhere on the face of the earth. He moved on at once to the alternative proposal that the bomb should be located in a rocket ship, an artificial moonlet flying in a free orbit around the earth at a convenient distance- say fifteen thousand miles-while secondary power stations on earth burned a safe fuel manufactured by the bomb.

He announced the discovery the Harper-Erickson technique and dwelt on what it meant to them commercially. Each point was presented as persuasively as possible, with the full power of his engaging personality. Then he paused and waited for them to blow off steam.

They did. "Visionary-" "Unproved-" "No essential change in the situation-" The substance of it was that they were very happy to hear of the new fuel, but not particularly impressed by it. Perhaps in another twenty years, after it had been thoroughly tested and proved commercially, they might consider setting up another breeder pile outside the atmosphere. In the meantime there was no hurry. Only one director supported the scheme and he was quite evidently unpopular.

Lentz patiently and politely dealt with their objections. He emphasized the increasing incidence of occupational psychoneurosis among the engineers and the grave danger to everyone near the bomb even under the orthodox theory. He reminded them of their insurance and indemnity bond costs, and of the "squeeze" they paid state politicians. Then he changed his tone and let them have it directly and brutally. "Gentlemen," he said, "we believe that we are fighting for our lives ... our own lives, our families, and every life on the globe, if you refuse this compromise, we will fight as fiercely and with as little regard for fair play as any cornered animal." With that he made.His first move in attack. It was quite simple. He offered for their inspection the outline of a propaganda campaign on a national scale, such as any major advertising firm could carry out as a matter of routine. It was complete to the last detail, television broadcasts, spot plugs, newspaper and magazine coverage with planted editorials, dummy "citizens' committees," and-most important-a supporting whispering campaign and a letters-to-Congress organization. Every businessman there knew from experience how such things worked.

But its object was to stir up fear of the Arizona pile and to direct that fear, not into panic, but into rage against the Board of Directors personally, and into a demand that the Atomic Energy Commission take action to have the Big Bomb removed to outer space.

"This is blackmail! We'll stop you!"

"I think not," Lentz replied gently. "You may be able to keep us out of some of the newspapers, but-you can't stop the rest of it. You can't even keep us off the air-ask the Federal Communications Commission." It was true. Harrington had handled the political end and had performed his assignment well; the President was convinced.

Tempers were snapping on all sides; Dixon had to pound for order. "Doctor Lentz," he said, his own temper under taut control, "you plan to make every-one of us appear a black-hearted scoundrel with no oilier thought than personal profit, even at the expense of the lives of others. You know that is not true; this is a simple difference of opinion as to what is wise."

"I did not say it was true," Lentz admitted blandly, "but you will admit that I can convince the public that you are deliberate villains. As to it being a difference of opinion ... you are none of you atomic physicists; you are not entitled to hold opinions in this matter.

"As a matter of fact," he went on callously, "the only doubt in my mind is whether or not an enraged public will destroy your precious plant before Congress has time to exercise eminent domain, and take it away from you!"

Before they had time to think up arguments in answer and ways of circumventing him, before their hot indignation had cooled and set as stubborn resistance, he offered his gambit. He produced another lay-out for a propaganda campaign-an entirely different sort.

This time the Board of Directors was to be built up, not torn down. All of the same techniques were to be used; behind-the-scenes feature articles with plenty of human interest would describe the functions of the Company, describe it as a great public trust, administered by patriotic, unselfish statesmen of the business world. At the proper point in the campaign, the Harper-Erickson fuel would be announced, not as a semi-accidental result of the initiative of two employees, but as the long-expected end product of years of systematic research conducted under an axed policy of the Board of Directors, a policy growing naturally out of their humane determination to remove forever the menace from even the sparsely settled Arizona desert.

No mention was to be made of the danger of complete, planet-embracing catastrophe.

Lentz discussed it. He dwelt on the appreciation that would be due them from a grateful world. He invited them to make a noble sacrifice, and, with subtle misdirection, tempted them to think of themselves as heroes. He deliberately played on one of the most deep-rooted of simian instincts, the desire for approval from one's kind, deserved or not.

All the while he was playing for time, as he directed his attention from one hard case, one resistant mind, to another; He soothed and he tickled and he played on personal foibles. For the benefit of the timorous and the devoted family men, he again painted a picture of the suffering, death, and destruction that might result from their well-meant reliance on the unproved and highly questionable predictions of Destry's mathematics. Then he described in glowing detail a picture of a world free from worry but granted almost unlimited power, safe power from an invention which was theirs for this one small concession. It worked. They did not reverse themselves all at once, but a committee was appointed to investigate the feasibility of the proposed spaceship power plant. By sheer brass Lentz suggested names for the committee and Dixon confirmed his nominations, not because he wished to, particularly, but because he was caught off guard and could not think of a reason to refuse without affronting those colleagues. Lentz was careful to include his one supporter in the list.

The impending retirement of King was not mentioned by either side. Privately, Lentz felt sure that it never would be mentioned.

It worked, but there was left much to do. For the first few days, after the victory in committee, King felt much elated by the prospect of an early release from the soul killing worry. He was buoyed up by

pleasant demands of manifold new administrative duties. Harper and Erickson were detached to Goddard Field to collaborate with the rocket engineers there in design of firing chambers, nozzles, fuel stowage, fuel metering, and the like. A schedule had to be worked out with the business office to permit as much use of the pile as possible to be diverted to making atomic fuel, and a giant combustion chamber for atomic fuel had to be designed and ordered to replace the pile itself during the interim between the time it was shut down on earth and the later time when sufficient local, smaller plants could be built to carry the commercial load. He was busy.

When the first activity had died down and they were settled in a new routine, pending the shutting down of the plant and its removal to outer space, King suffered an emotional reaction. There was, by then, nothing to do but wait, and tend the pile, until the crew at Goddard Field smoothed out the bugs and produced a space-worthy rocket ship.

At Goddard they ran into difficulties, overcame them, and came across more difficulties. They had never used such high reaction velocities; it took many trials to find a nozzle shape that would give reasonably high efficiency. When that was solved, and success seemed in sight, the jets burned out on a time-trial ground test. They were stalemated for weeks over that hitch.

There was another problem quite separate from the rocket problem: what to do with the power generated by the breeder pile when relocated in a satellite rocket? It was solved drastically by planning to place the pile proper outside the satellite, unshielded, and let it waste its radiant energy. It would be a tiny artificial star, shining in the vacuum of space. In the meantime research would go on for a means to harness it again and beam the power back to Earth. But only its power would be wasted; plutonium and the never atomic fuels would be recovered and rocketed back to Earth.

Back at the power plant Superintendent King could do nothing but chew his nails and wait He had not even the release of running over to Goddard Field to watch the progress of the research, for, urgently as he desired to, he felt an even stronger, an overpowering compulsion to watch over the pile more lest it heartbreakingly blow up at the last minute.

He took to hanging around the control room. He had to stop that; his unease communicated itself to his watch engineers; two of them cracked up in a single day-one of them on watch.

He must face the fact-there had been a grave upswing in psychoneurosis among his engineers since the period of watchful waiting had commenced. At first, they had tried to keep the essential facts of the plan a close secret, but it had leaked out, perhaps through some member of the investigating committee. He admitted to himself now that it had been a mistake ever to try to keep it secret-Lentz had advised against it, and the engineers not actually engaged in the change-over were bound to know that something was up.

He took all of the engineers into confidence at last, under oath of secrecy that had helped for a week or more, a week in which they were all given a spiritual lift-by the knowledge, as he had been. Then it had worn off, the reaction had set in, and the psychological observers had started disqualifying engineers for duty almost daily. They were even reporting each other as mentally unstable with great frequency; he might even be faced with a shortage of psychiatrists if that kept up, he thought to himself with bitter amusement. His engineers were already standing four-hours in every sixteen. If one more dropped out, he'd put himself on watch. That would be a relief, to tellhimself the truth.

Somehow some of the civilians around about and the non-technical employees were catching on to the secret.

That mustn't go on-if it spread any further there might be a nationwide panic. But how the hell could he stop it? He couldn't.

He turned over in bed, rearranged his pillow, and tried once more to get to sleep. No good. His head ached, his eyes were balls of pain, and his brain was a ceaseless grind of useless, repetitive activity, like a disc recording stuck in one groove.

God! This was unbearable! He wondered if he were cracking up if he already had cracked up. This was worse, many times worse, than the old routine when he had simply acknowledged the danger and tried to forget it as much as possible. Not that the pile was any different-it was this five-minutes-to-armistice feeling, this waiting for the curtain to go up, this race against time with nothing to do to help. He sat up, switched on his bed lamp, and looked at the clock.Three-thirty. Not so good. He got up, went into his bathroom, and dissolved a sleeping powder in a glass of whisky and water, half and half. He gulped it down and went back to bed. Presently he dozed off.

He was running, fleeing down a long corridor. At the end lay safety he knew that, but he was so utterly exhausted that he doubted his ability to finish the race. The thing pursuing him was catching up; he forced his leaden, aching legs into greater activity. The thing behind him increased its pace, and actually touched him. His heart stopped,then pounded again. He became aware that he was screaming, shrieking in mortal terror. But he had to reach the end of that corridor, more depended on it than justhimself . He had to. He had to- He had to! Then the flash came and he realized that he had lost, realized it with utter despair and utter, bitter defeat. He had failed; the pile had blown up.

The flash was his bed lamp coming on automatically; it was seven o'clock. His pajamas were soaked, chipping with sweat, and his heart still pounded. Every ragged nerve throughout his body screamed for release. It would take more than a cold shower to cure this case of the shakes.

He got to the office before the janitor was out of it. He sat there, doing nothing, until Lentz walked in on him, two hours later. The psychiatrist came in just as he was taking two small tablets from a box in his desk.

"Easy ... easy, old man," Lentz said in a slow voice. "What have you there?" He came around and gently took possession of the box.

"Just a sedative."

Lentz studied the inscription on the cover. "How many have you had today?"

"Just two, so far."

"You don't need barbiturates; you need a walk in the fresh air. Come take one with me."

"You're a fine one to talk you're smoking a cigarette that isn't lighted!"

"Me? Why, so I am! We both need that walk. Come."

Harper arrived less than ten minutes after they had left the office. Steinke was not in the outer office. He walked on through and pounded on the door of King's private office, then waited with the man who accompanied him a hard young chap with an easy confidence to his bearing. Steinke let them in.

Harper brushed on past him with a casual greeting, then checkedhimself when he saw that there was

no one else inside.

"Where's the chief?" he demanded.

"Out.He'll be back soon."

"I'll wait. Oh-Steinke, this is Greene. Greene Steinke."

The two shook hands. "What brings you back, Cal?" Steinke asked, turning back to Harper.

'Well... I guess it's all right to tell you-"

The communicator screen flashed into sudden activity, and cut him short. A face filled most of the frame. It was apparently too close to the pickup, as it was badly out of focus. "Superintendent!" it yelled in an agonized voice."The pile-!"

A shadow flashed across the screen, they heard a dull "Smack!", and the face slid out of the screen. As it fell it revealed the control room behind it. Someone was down on the floor plates, a nameless heap. Another figure ran across the field of pickup and disappeared.

Harper snapped into action first. "That wasSilard !" he shouted, "-in the control room! Come on, Steinke!" He was already in motion himself.

Steinke went dead white, buthesitated only anunmeasurable instant. He pounded sharp on Harper's heels. Greene followed without invitation, in a steady run that kept easy pace with them.

They had to wait for a capsule to unload at the tube station. Then all three of them tried to crowd into a two passenger capsule. It refused to start and moments were lost before Greene piled out and claimed another car.

The four minute trip at heavy acceleration seemed an interminable crawl. Harper was convinced that the system had broken down, when the familiar click and sigh announced their arrival at the station under the plant. They jammed each other trying to get out at the same time.

The lift was up; they did not wait for it. That was unwise; they gained no time by it, and arrived at the control level out of breath. Nevertheless, they speeded up when they reached the top, zigzagged frantically around the outer shield, and burst into the control room.

The limp figure was still on the floor, and another, also inert, was near it.

A third figure was bending over the trigger. He looked up as they came in, and charged them. They hit him together, and all three went down. It was two to one, but they got in each other's way. His heavy armor protected him from the force of their blows. He fought with senseless, savage violence.

Harper felt a bright, sharp pain; his right arm went limp and useless. The armored figure was struggling free of them. There was a shout from somewhere behind them: "Hold still!"

He saw a flash with the corner of one eye, a deafening crack hurried on top of it, and re-echoed painfully in the restricted space.

The armored figure dropped back to his knees, balanced there, and then fell heavily on his face.

Greene stood in the entrance, a service pistol balanced in his hand.

Harper got up and went over to the trigger. He tried to reduce the power-level adjustment, but his right hand wouldn't carry out his orders, and his left was too clumsy.

"Steinke," he called, "come here! Take over."

Steinke hurried up, nodded as he glanced at the readings, and set busily to work.

It was thus that King found them when he bolted in a very few minutes later.

"Harper!" he shouted, while his quick glance was still taking in the situation. "What's happened?"

Harper told him briefly. He nodded. "I saw the tail end of the fight from my office Steinke!" He seemed to grasp for the first timewho was on the trigger. "He can't manage the controls-" He hurried toward him.

Steinke looked up at his approach. "Chief!" he called out, "Chief! I've got my mathematics back!"

King looked bewildered, then nodded vaguely, and let him be. He turned back to Harper. "How does it happen you're here?"

"Me? I'm here to report-we've done it, Chief!"

"Eh?"

"We've finished; it's all done. Erickson stayed behind to complete the power plant installation on the big ship. I came over in the ship we'll use to shuttle between Earth and the big ship, the power plant. Four minutes from Goddard Field to here in her. That's the pilot over there." He pointed to the door, where Greene's solid form partially hid Lentz.

"Wait a minute. You say that everything is ready to install the pile in the ship? You're sure?"

"Positive. The big ship has already flown with our fuel-longer and faster than she will have to fly to reach station in her orbit; I was in it-out in space, Chief! We're all set, six ways from zero."

King stared at the dumping switch, mounted behind glass at the top of the instrument board. "There's fuel enough," he said softly, as if he were alone and speaking only tohimself , "there's been fuel enough for weeks."

He walked swiftly over to the switch, smashed the glass with his fist, and pulled it.

The room rumbled and shivered as tons of molten, massive metal, heavier than gold, coursed down channels, struck against baffles, split into a dozendozen streams, and plunged to rest in leaden receivers-to rest, safe and harmless, until it should be reassembled far out in space.